Precovery of near-Earth asteroids by a citizenscience project of the Spanish Virtual Observatory

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Discovery alone is not enough to quantify the thread level of a near-Earth asteroid (NEA). Above all, it is necessary to compute reliable orbits through accurate astrometric positions covering a period of time as long as possible. Precovery (short for "pre-discovery recovery") is the term that describes the process of identifying an object in archive data whose presence was not detected at the time the observation was made.

The importance of precovery was clearly proved with the discovery of Apophis in December 2004. Follow-up observations performed within one week after its discovery rose Apophis to an unprecedented level of hazard alert in the Torino Scale. It was not until the use of precovery positions taken in March 2004 (nine months before discovery) when the impact in 2029 could be ruled out.

Every single image taken by the most important ground and space-based astronomical observatories eventually ends up in open archives, freely available on the web. Moreover, some of these archives comply with the standards defined by the International Virtual Observatory Alliance (IVOA), which guarantees an efficient data discovery, access and analysis. These large datasets represent an immensely data-rich field where the general public can significantly contribute, in particular in projects related to classification, pattern recognition and outlier identification where the visual inspection has proved exceptionally good in complementing (and, sometimes, improving) computer search algorithms.

In this paper we describe a citizen-science project designed by the Spanish Virtual Observatory (SVO) to precover NEAs in the Eight Data Release of the Sloan Digital Sky Survey. Through visual inspection of sequences of images, the user is requested to identify the asteroid and measure its coordinates (Figure 1). After passing a number of quality checks, the asteroid positions are sent to the Minor Planet Center (MPC) to improve the associated orbital parameters. The project gives the public the opportunity to participate in an attractive initiative going through the same steps as professional astronomers (data acquisition, data analysis and publication of results) and making useful contributions to a better knowledge of potential threads of collision with the Earth. The public release of the system took place on July 2011 and, after fifteen months, more than 3000 users have participated in it.

Among other results we highlight the identification of precovery observations for 130 NEAs. Thirty-one, eighteen and two (2010 FC6, 2011 MB2) of these NEAs have extended their arc lengths more than one thousand, two thousand and four thousand days, respectively. It is important to remark that none of these asteroids were detected by the SDSS photometric pipeline which clearly stress the successful of the project.

Our main goal in the mid-term is to expand the capabilities of the system by including new surveys (VISTA and UKIDSS), new functionalities (Fast Response) and new types of asteroids (Mars crossers). .

A full description of the project can be found in Solano et al. (2013)[1,2] .

Referencias

1. E. Solano, C. Rodrigo, R. Pulido, and B. Carry arXiv:1302.5375 .
2. http://www.laeff.cab.inta-csic.es/projects/near/main/

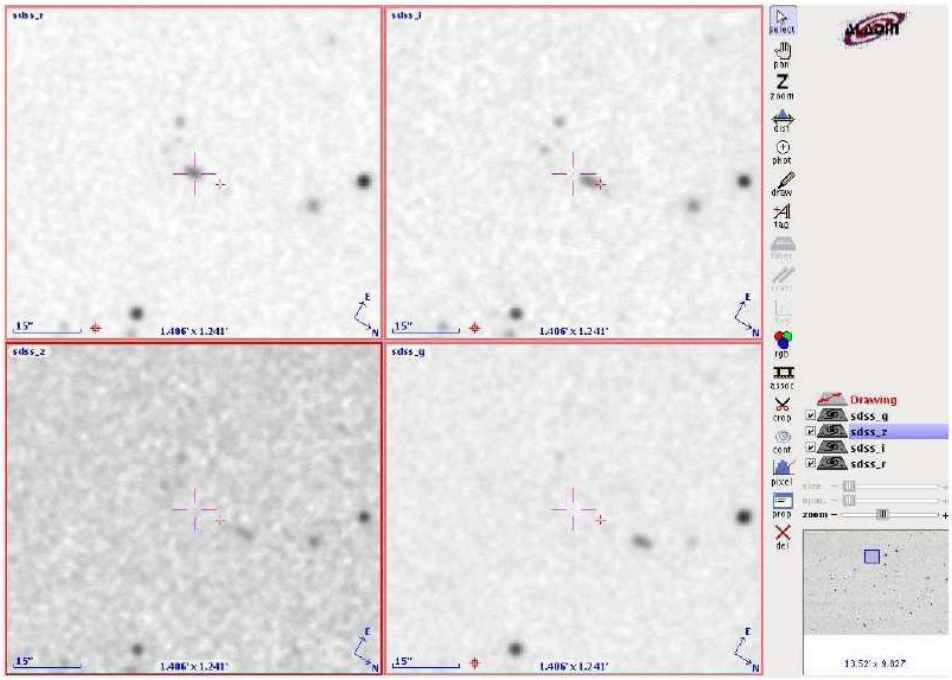

Figura 1. Asteroid identification. The asteroid 2007 JZ20 is clearly seen moving in the sequence of SDSS images from South to North. The small red cross indicates the expected position as computed by NEODyS. The user must put the large magenta cross on the asteroid and submit the coordinates.

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